

### 3.15 WAVEFORM GENERATOR

There are five characteristics of the waveform generator FE that are identified in the ESAMS CMS. These are transmitted power, frequency, pulse repetition frequency (PRF), pulse width, and duty cycle. (Duty cycle is defined as pulse width times PRF and is not an independent characteristic). Variations in power affect primarily acquisition and lock-on ranges. In accordance with the radar range equation which is used in ESAMS to compute signal powers, detection range varies as the fourth root of the transmitter power. Variations in transmitter frequency (or equivalently, wavelength) also primarily affect detection range since detection range varies as the square root of the wavelength in the radar range equation. Frequency can also affect signal propagation through diffraction and multipath effects, but these sensitivities are more appropriately examined in the propagation functional area. The waveform characteristics with the greatest potential for affecting target tracking and missile flyout performance are PRF and pulse width. These are examined in this section.

#### 3.15.1 Objectives and Procedures

Real radar transmitters are not perfectly stable as implicitly assumed in ESAMS, and as a consequence, the PRF will “jitter” randomly from one pulse to the next and the pulse width and/or pulse shape may vary. The objective of the analysis in this section is to determine the level of sensitivity to PRF jitter and pulse width.

PRF jitter was examined by adding a code modification in subroutine RNGDSC which called subroutine GAUSS to generate a normally distributed random deviate around the expected pulse time-of-arrival (variable PTAR). The standard deviation of the normal distribution was assumed to be a percentage of the pulse width, either 1, 3, or 5%. The affect of this jitter on target tracking and missile flyout performance for the SMART baseline system were examined.

The second sensitivity involved varying the pulse width while keeping the range gate constant. By default, the pulse width is about 41% as wide as the range gate, and in this analysis, pulse widths one-tenth, one-half, and twice as large as the default pulse width were input via an RDRD common block overlay. For threat radars that use the waveform-driven methodology, the user must identify the RWFARY element that corresponds to the pulse width in each coherent pulse interval (CPI). As with the PRF jitter, track errors and missile flyout trajectories were examined for variations from the baseline performance.

#### 3.15.2 Results

The effect of PRF jitter on range tracking errors is plotted in Figure 3.15-1 and exhibits increasing dispersion with increasing jitter. The standard deviation in the range error is 0.02, 0.23, 0.68, and 1.08 meters for jitters of 0, 1, 3, and 5% of the pulse width. Range tracking errors for even the 5% jitter were sufficiently small that they had no significant impact on the missile flyout performance.

Range tracking errors as a function of pulse width are plotted in Figure 3.15-2, and exhibit increasing error dispersion with decreasing pulse width. The standard deviations in range errors over the 10 second interval plotted are 1.25, 0.74, 6.34, and 7.15 meters for pulse widths twice the default, the default, one-half the default, and one-tenth the default, respectively. As was the case for the PRF jitter, even the largest tracking errors are sufficiently small that they have no significant effect on missile flyout performance.

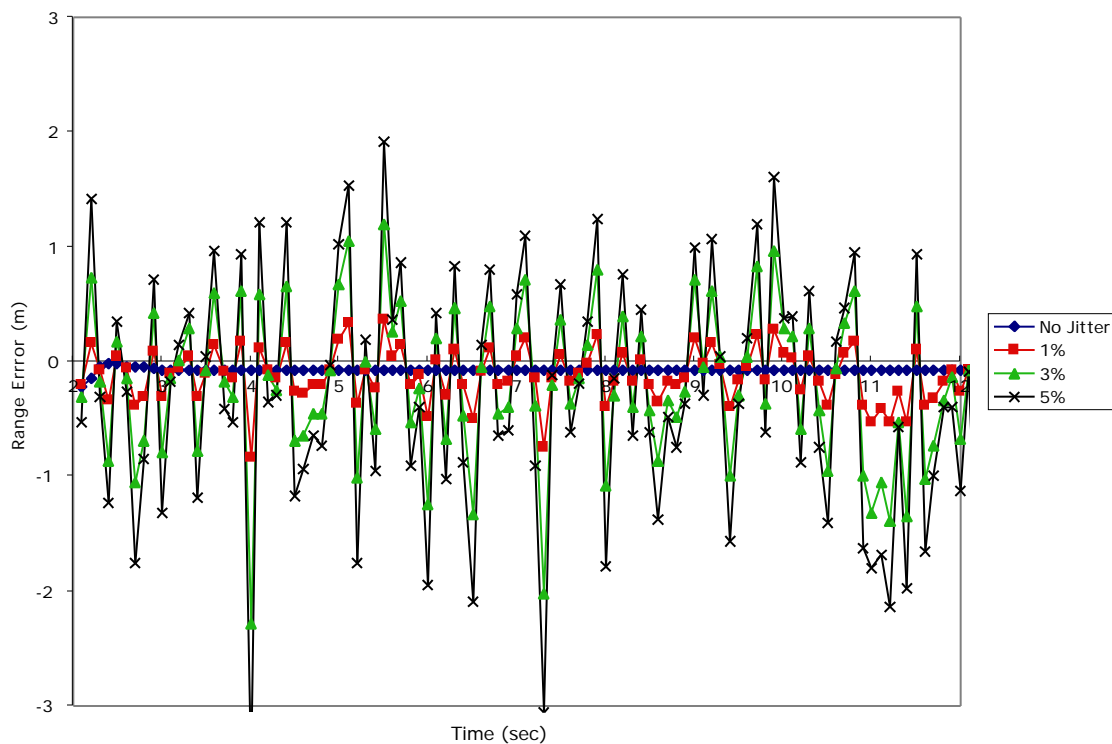


FIGURE 3.15-1. Range Track Error as a Function of PRF Jitter.

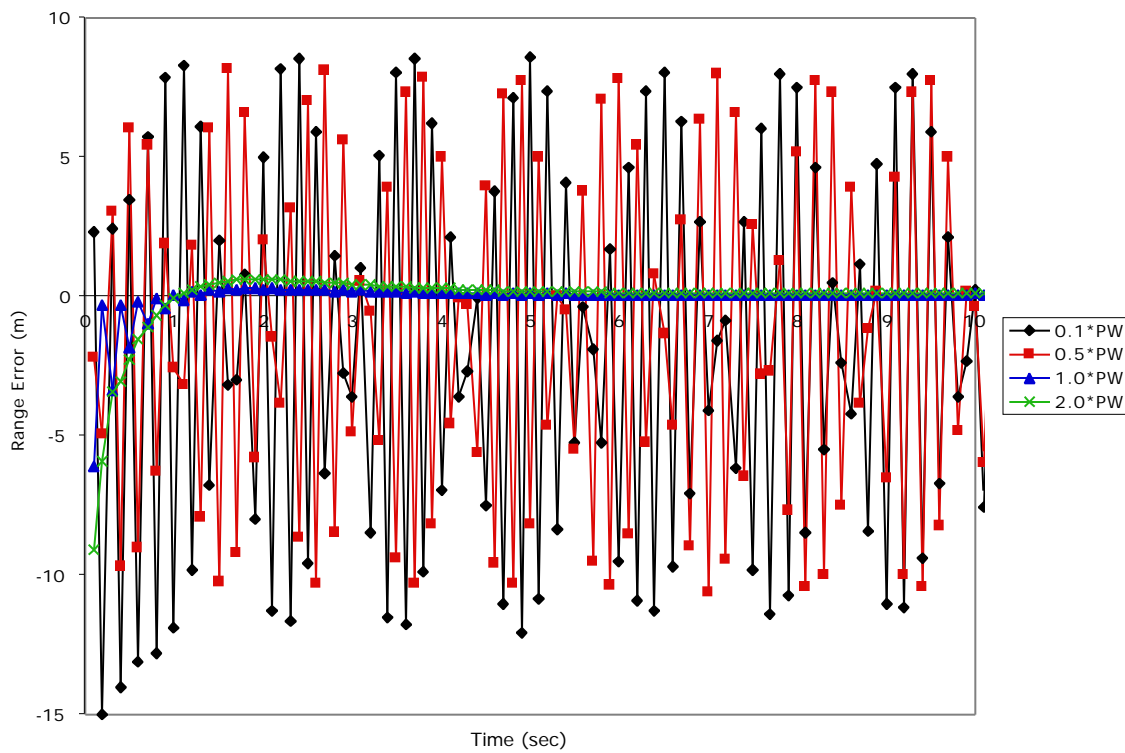


FIGURE 3.15-2. Range Track Error as a Function of Pulse Width.

### 3.15.3 Conclusions

Variations in both PRF jitter and pulse width can affect range tracking errors; however, even the largest errors obtained are still sufficiently small that they had no significant affect on missile flyout performance.

